



Modeling Population Growth

Introduction: A population is a group of organisms that belong to the same species and live in the same area at the same time. There are no definite boundaries to a population. The boundaries of a population may result from a geographical feature, such as a lakeshore, or a researcher can arbitrarily define them. Population growth is determined by four factors: **the number of births, the number of deaths**, and the number of individuals **immigrating** and **emigrating**. In this activity, you will use your knowledge of mathematical equations to plot the growth of a population over time.

Purpose:

1. To calculate the growth of a population over time and plot the data on a graph.
2. To observe the effect of the carrying capacity on population size.
3. To distinguish between exponential growth and logistic growth.

Getting Started: You have been asked to determine the size and the growth rate of a population of rabbits over a 20-year period. You must use the following information to determine the size of the population each year. You will graph your data and answer the follow-up questions.

The Rabbit Population Statistics

- The initial population size in year 0 is 75 rabbits.
- The birth rate each year per 100 rabbits in the population is 50.
- The death rate each year per 100 rabbits in the population is 30.
- There is no migration.

Follow these steps to model and calculate the growth rate in a population of rabbits:

1. According to the information in the above box, will the rabbit population increase or decrease each year? How do you know?
2. Calculate the percent increase in the population each year.

$$\% \text{ change in population size} = (\text{Birth Rate} - \text{Death Rate}) / 100 \text{ rabbits}$$

3. Given the percent increase calculated in step 2 and the number of rabbits present in year 0, by how many rabbits will the population increase in the first year? Show your work.

$$\text{Increase in rabbit population} = (\text{percent increase}) (\text{current population})$$

4. At the end of year 1, what is the total size of the rabbit population? Show your work and record your answer in your data table.

$$\text{Next year rabbit population} = (\text{current population}) + (\text{percent increase}) (\text{current population})$$

5. Ready to calculate the population size each year? Wait! There is another piece of vital information! The rabbits have limited resources available to them. The rabbits live in an area that can only support **600 rabbits**. When the population reaches 600 rabbits, the birth rate and the death rate will be reversed. The birth rate per 100 rabbits will be 30. The death rate per 100 rabbits will be 50. Use the equations below to calculate the population for the remaining 20 years.

If population less than 600

Next year rabbit population = (current population) + (percent increase) (current population)

If population greater than 600

Next year rabbit population = (current population) - (percent increase) (current population)

6. Make a line graph showing your data on population growth over the 20-year period.
- Determine what variable to place on the x-axis and the y-axis.
 - Label each axis.
 - Scale each axis appropriately.
 - Title your graph.
 - Plot points as accurately as possible.
7. What happens to a population when the death rate is higher than the birth rate?
8. Define the term “carrying capacity”. Draw a line on your graph above representing the carrying capacity of the rabbits. Label the line.
9. What three factors determine the growth rate of a population?
10. Name and describe the type of growth that is occurring during the first 12 years.
11. Name and describe the type of growth that occurs after the 12 year mark.
12. What will happen to the birth rate and the death rate of a population when:
- a) resources are abundant?
 - b) resources are limited?
13. List three factors that might determine the carrying capacity of a population. (limiting factors)
14. Describe what happens in a population in the years following the reaching of its carrying capacity.
15. Explain what changes you would see in your graph if, in year 6, twenty new rabbits immigrated into this population.
16. Assume that a pair of mice produces 6 offspring, and that half the offspring are male and half are female. Further, assume that no offspring die. If each pair of rabbits breeds only once, how many offspring would be produced each year for 5 years?

Data Table: Population Change Over a 20-Year Period

YEAR	Population Size: Show calculation and answer
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

**** Round to a whole number of rabbits.**

Title: _____

